Appendix D

Parameters and Health Effects for Site Contaminants

Mercury

Adverse health effects:

The chemical form of mercury has a profound influence on its disposition. For all practical purposes there are three general forms of mercury; elemental mercury (Hg^0), inorganic mercury (Hg^{1+} and Hg^{2+}), and organic mercury. The distribution of mercury varies considerably, depending on the chemical form and on the route of exposure. Chronic mercury poisoning due to intake of Hg^{2+} is essentially a renal problem, chronic mercury poisoning due to inhalation of Hg^0 is a disease of the central nervous system. The disposition of organic mercury compounds is, in general, unlike that of Hg^{2+}. Most notable is the disposition of methyl mercury with substantially higher concentrations going to the brain and blood, after a preferential disposition to the kidney.

Toxic manifestations of inorganic mercury are renal whereas those for methyl mercury poisoning are neurologic.[6] Mercury has toxic effects involving numerous organs and systems. The major target organs are the central nervous system and the kidney.[6]

Environmental fate:

Mercury is naturally present in soil, but the concentration is typically less than 1.0 ppm.[7] Mercury is strongly sorbed to inorganic and organic particulates. The mercury present from natural or man-made sources is invariably toxic.[8] Soil micro-organisms are capable of volatilizing metallic mercury (Hg^0) from phenylmercury acetate, ethylmercuric acetate, and mercuric and mercurous ions. Soil organisms can also methylate mercury and demethylate methylated mercury compounds. Methylation reactions in soil can produce monomethylmercury (CH_3Hg^+) or dimethylmercury (CH_3HgCH_3) from mercuric ions or some mercury compounds. Methylmercury is both volatile and quite poisonous, but is, in turn, destroyed by soil bacteria.[7] With a moderately oxidizing environment above pH5, the predominant species will be elemental mercury.[8]

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1 IRIS. 1992. National Library of Medicine
2 HEAST, 1992. OHEA ECAO-CIN-821.
3 DOE/ID-10340 (91)
4 From sample data.
5 HSDB. 1992. National Library of Medicine.
6 Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
7 Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
8 Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Appendix D
Contaminant Table

Mercury

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (mg/kg).[4]				
Site CPP-32E	0.16 - 0.30		3.0E+01	Maximum concentration detected
Concentration in ground water (mg/l).[4]				
Site CPP-32E			3.4E-11	As predicted by GWSCREEN Model
Chronic Oral RfD[2] (Inorganic)			3E-4 mg/kg/day	Under review, subject to change.
UF			1000	Interhuman, sensitive receptor, & interspecies variability
Chronic Inhalation RfC[2](Inorganic) Under review,			3E-4 mg/cu.m	Specific for Hg.[0] subject to change.
UF			30	Less than chronic study.Neurotoxicity. Sensitive receptor.
Carcinogenicity Classification[1]			D	Not classified as to *human* carcinogenicity.
Molecular weight			200.6	
Distribution Coefficient Kd[3]			100	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Tritium (H-3)

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]
Tritium is a radioactive isotope of hydrogen (3H).[6]
Tritium, as tritiated water, is readily absorbed into the bloodstream from the gastrointestinal tract, skin, and lungs and distributes as body water. Body water is considered to be the critical organ since no tissue has a higher proportion of hydrogen. Any radiation effects from absorbed tritiated water, are comparable to whole-body irradiation.[6]

Environmental fate:

Tritium is reactive and mobile in the environment. It readily exchanges with non-radioactive hydrogen, in the body, in water, and in soils. Because of its low energy, tritium cannot be accurately measured in soils.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			2.49E+04	Concentration estimated from waste tank data and report of incident.
Concentration in ground water (pCi/l).[4]				
Site CPP-28			3.9E+00	As predicted by GWSCREEN model
Ingestion				
Slope Factor[2]			5.4E-14 risk/pCi	
Inhalation				
Slope Factor[2]			7.8E-14 risk/pCi	Gas

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Tritium (H3) continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
External Exposure Slope Factor[2]			0.0E+00 risk/yr per pCi/g soil	No gamma radiation
Molecular weight			3	
Distribution Coefficient Kd[3]			0	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cobalt-60

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Although cobalt is a constituent of vitamin B_{12} and an essential element, non-radioactive cobalt has been found to be carcinogenic under specific experimental conditions; i.e., cancer formation at the point of application.[6]
Cobalt salts are well absorbed after oral ingestion, with 80% of the ingested cobalt excreted in the urine. The muscle contains the largest total fraction, but fat has the highest concentration. [6]
The most significant adverse health effects from chronic exposure to radioactive cobalt (isotope 60) are the carcinogenic effects due to radiation.[6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			2.3E+04	Concentration estimated from waste tank data and report of incident.
Site CPP-31	24.5 - 336	7.2E+01/121	1.2E+02	95% upper confidence limit
Concentration in ground water (pCi/l).[4]				
Site CPP-28			9.5E-172	As predicted by GWSCREEN
Site CPP-31			1.2E-173	
Ingestion Slope Factor[2]			1.5E-11 risk/pCi	
Inhalation Slope Factor[2]			1.5E-10 risk/pCi	Lung clearance-Year

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cobalt-60 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
External Exposure Slope Factor[2]			8.6E-06 risk/yr per pCi/g soil	
Molecular weight			60	
Distribution Coefficient Kd[3]			10	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Strontium-90

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Strontium is an alkaline earth element, a metabolic analog of calcium, readily absorbed from the gastrointestinal tract or the lung into the blood stream and is subsequently deposited in bone. A simple brief intake orally, intravenously, or by inhalation results in a high incidence of neoplasia of bone and bone-related tissue (osteosarcomas, hemangeosarcoma, fibrosarcoma and epidemoid carcinomas).[6]

Chemical toxicity from the non-radioactive strontium is nil.[6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	33.8-15,800	5,654/10,732	210 Occupational	Maximum concentration detected in the upper 4'
			11,000 Residential	95% upper confidence level of the mean
Site CPP-28	5.7E+07		5.7E+07	Concentration estimated from waste tank data and report of incident.
Site CPP-31	1.6E+05-7.1E+5	3.3E+5/5.3E+5	5.3E+5	95% upper confidence level
Site CPP-32E	153-278		2.8E+02	Maximum concentration detected

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Strontium-90 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-79	12-54.4		Not determined	All contamination at depths > 14 feet bls.
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			1.3E-05	As predicted by
Site CPP-31			2.5E-178	GWSCREEN
Site CPP-32E			2.3E-13	model.
Ingestion				
Slope Factor[2] includes daughter product (Yttrium-90)			3.6E-11 risk/pCi	
Inhalation				
Slope Factor[2] includes daughter product (Yttrium-90)			6.2E-11 risk/pCi	Lung clearance -Day
External Exposure				
Slope Factor[2]			0.0E+00 risk/yr per pCi/g soil	No gamma radiation
Molecular weight			90	
Distribution Coefficient				
Kd[3]			3	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Ruthenium-106

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Toxicologic information about the adverse health effects from exposure to non-radioactive ruthenium is limited to references in the literature indicating that fumes may be injurious to eyes and lungs. Ruthenium may be retained in the lungs after inhalation exposure.[6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g). [4]				
Site CPP-28			5.4E-01	Concentration estimated from waste tank data and report of incident.
Site CPP-31			6.7E-02	Maximum concentration detected.
Concentration in ground water (pCi/l).[4]				
Site CPP-28			1.0E-04	As predicted by GWSCREEN
Site CPP-31			1.6E-02	
Ingestion Slope Factor[2]			9.5E-12 risk/pCi	
Inhalation Slope Factor[2]			4.4E-10 risk/pCi	Lung clearance - Year

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Ruthenium-106 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
External Exposure Slope Factor[2]			6.7E-07 risk/yr per pCi/g soil	Gamma radiation from daughter Rh-106
Molecular weight			106	
Distribution Coefficient Kd[3]			0	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cesium-134

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Cesium is an alkali metal element, which behaves as an analog of potassium. Irrespective of the mode of administration, it is rapidly absorbed into the bloodstream and distributed throughout the active tissues of the body.[6] Distribution of radioactive cesium throughout the body results in essentially whole-body irradiation. The chronic health effects of exposure to low levels of ionizing radiation are generally believed to be carcinogenic. [6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			7.6E+04	Concentration estimated from waste tank data and report of incident.
Site CPP-31	1.3E+0-2.4E+1	8.9E+0/14E+1	1/4E+01	95% upper confidence level.
Concentration in ground water (pCi/l).[4]				
Site CPP-28			2.1E-206	As predicted by
Site CPP-31			1.1E-212	GWSCREEN
Ingestion Slope Factor[2]			4.1E-11 risk/pCi	
Inhalation Slope Factor[2]			2.8E-11 risk/pCi	Lung Clearance-Day
External Exposure Slope Factor[2]			5.2E-06 risk/yr per pCi/g Soil	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cesium-134 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Molecular weight			134	
Distribution Coefficient Kd[3]			500	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cesium-137

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Cesium is an alkali metal element, which behaves as an analog of potassium. Irrespective of the mode of administration, it is rapidly absorbed into the bloodstream and distributed throughout the active tissues of the body.[6]
Distribution of radioactive cesium throughout the body results in essentially whole-body irradiation. The chronic health effects of exposure to low levels of ionizing radiation are generally believed to be carcinogenic. [6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	108-6,460	2,497/4917	260 Occupational	Maximum concentration detected in the upper 4'
			4,900 Residential	Maximum concentration detected in upper 10'
Site CPP-28			1.0E+08	Concentration estimated from waste tank data and report of incident.
Site CPP-31	1.2E+3-2.2E+6	5.6E+5/9.0E+5	9E+5	95% upper confidence limit.
Site CPP-32E	133-277		2.8E+02	Maximum concentration detected

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Cesium-137 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-79	0.048-20.9		Not determined	All contamination at depths > 14 feet bls.
Concentration in ground water (pCi/L).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			1.9E-214	As predicted by GWSCREEN model.
Site CPP-31			1.1E-214	
Site CPP-32E			5.2E-221	
Ingestion Slope Factor Includes daughter Barium-137m			2.8E-11 risk/pCi	
Inhalation Slope Factor Includes daughter Barium-137m			1.9E-11 risk/pCi	Lung Clearance - Day
External Exposure Slope Factor Includes daughter Barium-137m			2.0E-06 risk/yr per pCi/g soil	
External dose-rate factor for exposure to contaminated ground surface[3]			5.7E+05 mrem,yr $^{-1}$/μCi/cm^2	
Molecular weight			137	
Distribution Coefficient Kd[3]			500	

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Europium-154

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2] Other adverse health effects due to chemical or physical properties are *not known.*[6]

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	0.163-10.7	3.64/7.16	6.5E-01 Occupational	Maximum concentration detected in the upper 4'
			7.2E+00 Residential	Maximum concentration detected in upper 10'
Site CPP-28			5.7E+05	Concentration estimated from waste tank data and report of incident.
Site CPP-31	1.9E+2-8.4E+2	1.0E+3/1.5E+3	1.5E+03	95% upper confidence limit.
Site CPP-32E			8.1E-01	Maximum concentration detected
Concentration in ground water (pCi/l).[4]				
Site CPP-26			*Not determined*	*Area and* volume of contamination unknown

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Europium-154 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in ground water (pCi/l).[4]				
Site CPP-28			0	As predicted by
Site CPP-31			1.1E+3	GWSCREEN
Site CPP-32E			9.1E-28	Model.
Ingestion				
Slope Factor[2]			3.0E-12 risk/pCi	
Inhalation				
Slope Factor[2]			1.4E-10 risk/pCi	Lung clearance-Week
External Exposure				
Slope Factor[2]			4.1E-06 risk/yr per pCi/g soil	
Molecular weight			154	
Distribution Coefficient				
Kd[3]			NA	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Neptunium-237

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2] Other adverse health effects of neptunium-237 are not known. It is assumed that the most significant biological effect, carcinogenicity, is caused by radioactivity. Neptunium-237 is the daughter product of the radioactive decay of uranium-237 and uranium-238.

Neptunium-237 is the parent of protactinium-233, uranium-233, etc..

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			1.6	Concentration estimated from waste tank data and report of incident.
Concentration in ground water pCi/l).[4]				
Site CPP-28			2E-03	
Ingestion				
Slope Factor[2]			2.2E-10 risk/pCi	Decay chain products included.
Inhalation				
Slope Factor[2]			2.9E-08 risk/pCi	Decay chain products included.
External Exposure				
Slope Factor[2]			4.3E-07 risk/yr per pCi/g soil	Decay chain products included.

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Neptunium-237 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Molecular weight			237	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Americium-241

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2] Other adverse health of americium-241 are not known. It is assumed that the most significant biological effect, carcinogenicity, is caused by radioactivity.

Americium-241 is the daughter product of the radioactive decay of plutonium-241.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	0.144-1.34	0.47/0.8	1.3 E-00 Occupational	Maximum concentration detected in the upper 4'
			8.0E-01 Residential	Maximum concentration detected in upper 10'
Site CPP-28	1.5E+06		1.5E+06	Concentration estimated from waste tank data and report of incident.
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			1.4E-82	As predicted by GWSCREEN model.

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Americium-241 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Ingestion Slope Factor[2]			2.4E-10 risk/pCi	
Inhalation Slope Factor[2]			3.2E-08 risk/pCi	Lung Clearance-Week
External Exposure Slope Factor[2]			4.9E-09 risk/yr per pCi/g soil	
Molecular weight			241	
Distribution Coefficient Kd[3]			340	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] *From sample data.*
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-234

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Uranium-234, -235, and -238 are natural actinide elements. The insoluble forms of uranium are largely nephrotoxic with the effects of this low-specific-activity material thought to be due to the chemical rather than the radiation effects. The insoluble salts of uranium have prolonged retention by the lungs. The soluble form, the uranyl ion is rapidly absorbed from the gastrointestinal tract. About 60% is carried as a soluble bicarbonate complex, while the remainder is bound to plasma proteins. About 25% may be fixed in bone.

For Track 1 and Track 2 investigations, all radioactive contaminants are considered carcinogenic compounds, which is the most conservative approach.

Uranium-234 is the daughter product from plutonium-238, and a descendant of thorium-234. Uranium-234 is the parent of protactinium-234, thorium-230, radium-226, radon-222, etc.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	0.979-2.21	1.26/1.57	2.2E+00 Occupational	Maximum concentration detected in the upper 4'
			1.6E+00 Residential	Maximum concentration detected in upper 10'
Site CPP-28	21.0		21.0	Concentration estimated from waste tank data and report of incident.

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-234 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			7.6E-2	As predicted by GWSCREEN model.
Ingestion Slope Factor[2]			1.6E-11 risk/pCi	
Inhalation Slope Factor[2]			2.6E-08 risk/pCi	Lung Clearance-Year
External Exposure Slope Factor[2]			3.0E-11 risk/yr per pCi/g soil	
Molecular weight			234	
Distribution Coefficient Kd[3]			6	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-235

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

Uranium-234, -235, and -238 are natural actinide elements. The insoluble forms of uranium are largely nephrotoxic with the effects of this low-specific-activity material thought to be due to the chemical rather than the radiation effects. The insoluble salts of uranium have prolonged retention by the lungs.

The soluble form, the uranyl ion is rapidly absorbed from the gastrointestinal tract. About 60% is carried as a soluble bicarbonate complex, while the remainder is bound to plasma proteins. About 25% may be fixed in bone.

For Track 1 and Track 2 investigations, all radioactive contaminants are considered carcinogenic compounds, which is the most conservative approach.

Uranium-235 is the parent of thorium-231, etc.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	7.4E-3-1.0E-1	0.05/0.07	1.0E-1 Occupational	Maximum concentration detected in the upper 4'
			7.0E-2 Residential	95% upper confidence limit.
Site CPP-28			2.4E-01	Concentration estimated from waste tank data and report of incident.
Site CPP-31	5.5E2-9.0E+3	2.9E+3/6.4E+3	6.4E+3	95% upper confidence limit.

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-235 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			8.7E-04	As predicted by GWSCREEN model.
Site CPP-31			8.6E-04	
Ingestion				
Slope Factor[2]			1.6E-11 risk/pCi	
Includes radiation from daughter products.				
Inhalation				
Slope Factor[2]			2.5E-08 risk/pCi	Lung Clearance-Year
Includes radiation from daughter products.				
External Exposure				
Slope Factor[2]			2.4E-07 risk/yr per pCi/g soil	
Includes radiation from daughter products.				
Molecular weight			235	
Distribution Coefficient				
Kd[3]			6	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-236

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

The insoluble forms of uranium are largely nephrotoxic with the effects of this low-specific-activity material thought to be due to the chemical rather than the radiation effects. The insoluble salts of uranium have prolonged retention by the lungs.

The soluble form, the uranyl ion is rapidly absorbed from the gastrointestinal tract. About 60% is carried as a soluble bicarbonate complex, while the remainder is bound to plasma proteins. About 25% may be fixed in bone.

For Track 1 and Track 2 investigations, all radioactive contaminants are considered carcinogenic compounds, which is the most conservative approach.

Uranium-236 is a daughter product of uranium-235.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4] Site CPP-28			7.6E-01	Concentration estimated from waste tank data and report of incident.
Concentration In ground water (pCi/l).[4] Site CPP-28			4.0E-14	As predicted by GWSCREEN model.
Ingestion Slope Factor[2]			1.5E-11 risk/pCi	

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Uranium-236 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Inhalation Slope Factor[2]			2.5E-08 risk/pCi	Lung Clearance-Year
External Exposure Slope Factor[2]			2.4E-11 risk/yr per pCi/g soil	
Molecular weight			236	
Distribution Coefficient Kd[3]			6	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-238

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is *carcinogenicity*.[2]

The plutoniums (-238, 239, 240, 241, and 242) are all actinide elements.
When inhaled, plutonium is retained in the lung with an effective half-life that varies from 100's of days for plutonium-oxides to tens of days for more soluble forms. A significant portion of the plutonium-oxides that leaves the lung is translocated to the tracheobronchial lymph nodes. Plutonium apparently solubilized within the lung is translocated to the liver and skeleton where it is tenaciously retained. Ingested and injected plutonium deposits primarily in the skeleton and liver.

Plutonium-238 is the daughter of neptunium-238, neptunium-237, and curium-242. Its daughter product is uranium-234.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	0.189-3.58	1.66/3.00	3.1 Occupational	Maximum concentration detected in the upper 4'
			3.0 Residential	95% upper confidence limit.
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Ingestion Slope Factor[2]			2.2E-10 risk/pCi	

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-238 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Inhalation Slope Factor[2]			3.9E-08 risk/pCi	Lung clearance - Year
External Exposure Slope Factor[2]			2.8E-11 risk/yr per pCi/g soil	
Molecular weight			238	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-239

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

The plutoniums (-238, 239, 240, 241, and 242) are all actinide elements.
When inhaled, plutonium is retained in the lung with an effective half-life that varies from 100's of days for plutonium-oxides to tens of days for more soluble forms. A significant portion of the plutonium-oxides that leaves the lung is translocated to the tracheobronchial lymph nodes. Plutonium apparently solubilized within the lung is translocated to the liver and skeleton where it is tenaciously retained. Ingested and injected plutonium deposits primarily in the skeleton and liver.

Plutonium-239 is the daughter of uranium-238, uranium-239, and neptunium-239. Its daughter product is uranium-235m.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-26	0.0132-0.841	0.34/0.7	1.6E-1 Occupational	Maximum concentration detected in the upper 4'
			7.0E-1 Residential	95% upper confidence limit.
Site CPP-28			1.3E+04	Concentration estimated from waste tank data and report of incident.
Site CPP-31	9.5E+1-1.5E+3	4.9E+2/1.1E+3	1.1E+3	95% upper confidence limit.

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[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-239 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in ground water (pCi/l).[4]				
Site CPP-26			Not determined	Area and volume of contamination unknown
Site CPP-28			1.6E+01	As predicted by GWSCREEN model.
Site CPP-31			6.7E+01	
Ingestion Slope Factor[2]			2.3E-10 risk/pCi	
Inhalation Slope Factor[2]			3.8E-08 risk/pCi	Lung clearance - Year
External Exposure Slope Factor[2]			1.7E-11 risk/yr per pCi/g soil	
Molecular weight			239	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-240

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

The plutoniums (-238, 239, 240, 241, and 242) are all actinide elements.
When inhaled, plutonium is retained in the lung with an effective half-life that varies from 100's of days for plutonium-oxides to tens of days for more soluble forms. A significant portion of the plutonium-oxides that leaves the lung is translocated to the tracheobronchial lymph nodes. Plutonium apparently solubilized within the lung is translocated to the liver and skeleton where it is tenaciously retained. Ingested and injected plutonium deposits primarily in the skeleton and liver.

Plutonium-240 is the daughter of uranium-238 (multiple n-capture), plutonium-239, and curium-244. Its daughter product is uranium-236.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			1.2E+4	Concentration estimated from waste tank data and report of incident.
Site CPP-31	9.5E+1-1.5E+3	4.9E+2/1.1E+3	1.1E+3	95% upper confidence limit.
Concentration in ground water (pCi/l).[4]				
Site CPP-28			2.1E-9	As predicted by GWSCREEN model.
Site CPP-31			1.5E+0	
Ingestion Slope Factor[2]			2.3E-10 risk/pCi	

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1 IRIS. 1992. National Library of Medicine
2 HEAST, 1992. OHEA ECAO-CIN-821.
3 DOE/ID-10340 (91)
4 From sample data.
5 HSDB. 1992. National Library of Medicine.
6 Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
7 Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
8 Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-240 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Inhalation Slope Factor[2]			3.8E-08 risk/pCi	Lung clearance - Year
External Exposure Slope Factor[2]			2.7E-11 risk/yr per pCi/g soil	
Molecular weight			240	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-241

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

The plutoniums (-238, 239, 240, 241, and 242) are all actinide elements.
When inhaled, plutonium is retained in the lung with an effective half-life that varies from 100's of days for plutonium-oxides to tens of days for more soluble forms. A significant portion of the plutonium-oxides that leaves the lung is translocated to the tracheobronchial lymph nodes. Plutonium apparently solubilized within the lung is translocated to the liver and skeleton where it is tenaciously retained. Ingested and injected plutonium deposits primarily in the skeleton and liver.

Plutonium-241 is the daughter of uranium-238 (multiple n-capture), plutonium-239, etc. Its daughter products is uranium-237 and americium-241.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4]				
Site CPP-28			1.1E+6	Concentration estimated from waste tank data and report of incident.
Concentration in ground water (pCi/l).[4]				
Site CPP-28			6.45E-137	As predicted by GWSCREEN model.
Ingestion Slope Factor[2]			3.6E-12 risk/pCi	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-241 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Inhalation Slope Factor[2]			2.3E-10 risk/pCi	Lung clearance - Year
External Exposure Slope Factor[2]			0.0E-00 risk/yr per pCi/g soil	No gamma radiations. Am-241 was also evaluated.
Molecular weight			241	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-242

Adverse health effects:

All radionuclides are classified as Class A human carcinogens. The principal adverse biological effect associated with exposures to radionuclide contamination in the environment is carcinogenicity.[2]

The plutoniums (-238, 239, 240, 241, and 242) are all actinide elements.
When inhaled, plutonium is retained in the lung with an effective half-life that varies from 100's of days for plutonium-oxides to tens of days for more soluble forms. A significant portion of the plutonium-oxides that leaves the lung is translocated to the tracheobronchial lymph nodes. Plutonium apparently solubilized within the lung is translocated to the liver and skeleton where it is tenaciously retained. Ingested and injected plutonium deposits primarily in the skeleton and liver.

Plutonium-242 is the daughter of americium-242 (multiple n-capture), uranium-238, protactinium-239, etc. Its daughter product is uranium-238.

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Concentration in soil (pCi/g).[4] Site CPP-28			3.2E+1	Concentration estimated from waste tank data and report of incident.
Concentration in ground water (pCi/l).[4] Site CPP-28			0.047	As predicted by GWSCREEN model
Ingestion Slope Factor[2]			2.2E-10 risk/pCi	

[1] IRIS. 1992. National Library of Medicine
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[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
[6] Casarett, L. J. 1980. Casarett and Doull's Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc. 778 pages.
[7] Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons, Inc. 466 pages.
[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.

Plutonium-242 continued

PARAMETER	RANGE	MEAN or 95% UCL	VALUE USED	RATIONALE
Inhalation Slope Factor[2]			3.6E-08 risk/pCi	Lung clearance - Year
External Exposure Slope Factor[2]			2.3E-11 risk/yr per pCi/g soil	
Molecular weight			242	
Distribution Coefficient Kd[3]			22	

[1] IRIS. 1992. National Library of Medicine
[2] HEAST, 1992. OHEA ECAO-CIN-821.
[3] DOE/ID-10340 (91)
[4] From sample data.
[5] HSDB. 1992. National Library of Medicine.
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[8] Callahan, etal. 1979. Water-related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA-440/4-79-029a.